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Cost Standards for a Model Stationary Custom Feed Mill for the Midwest

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PREFACE

This report on cost standards for a model stationary custom feed mill is a preliminary report on a project designed to analyze custom feed milling in the Midwest. The final report will analyze the costs and charges of offering these custom grinding and mixing services, and study portable or mobile custom milling as well as the model stationary mill operation.

The entire project is being conducted by the Midwest Research Institute, Kansas City, Mo., under contract with the Department. Publication of this report in preliminary form not only makes the data available to the industry at an earlier date but also permits the contractor and the Department to obtain comments and suggestions from the industry on the most useful method of presenting the final report.

The Department of Agriculture is interested in improving the efficiency of custom milling. Since farmers are heavy suppliers of ingredients as well as large consumers of custom services and products, they will benefit by increased efficiency and the cost reductions which may follow.

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Cost Standards for a Model Stationary Custom Feed Mill in the Midwest

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The purpose of this preliminary report is to establish a model stationary custom feed mill representative of some typical Midwestern operations and determine labor standards for this model mill. A model mill of this type is not designed as a blueprint for plant construction but rather as an aid to custom feed mill operators in better understanding their own operations and problems.

Efficient operation of the custom milling department requires a much better knowledge of operating costs and net incomes than is possessed by a majority of the operators. Since labor and capital expenditures constitute some of the most important operating cost items, this analysis should be of value to custom mill owners and operators. The formula feed industry has studied cost standards in larger mills but little information of this type is available for custom mills.

Custom grinding and milling is the process of grinding the farmers' locally produced grains and mixing them with balanced concentrates. As such it provides the farmer with another alternative to feeding the grain straight or selling it and purchasing commercial formula feeds. Custom milling provides the opportunity to obtain feeds mixed according to an infinite variety of formulas. This may either be an advantage or a disadvantage depending upon the degree of nutritional knowledge available to the farmer through his custom miller, the State agricultural experiment station, and the producer of any premix or mixing concentrate used. In the purchase of commercial formula feeds, most of these decisions are made for the farmer by the formula feed manufacturer.

Stationary custom milling and grinding in the Midwest is generally conducted as one department along with country grain elevators, farm machinery and equipment supplies, seed cleaning and other rural retail services. Frequently, the service feature of the custom milling operation is considered to be more important than any profit obtained from this service since it helps sell more molasses and concentrates, and keeps the farmer available for purchases of other related farm supply items.

Methodology

The model stationary custom mill and the cost standards for this typical Midwestern operation were established by the contractor based upon the following types of information:

(1) Data from 104 custom milling establishments in response to a mail survey.

(2) An analysis of 36 of these custom milling establishments. This analysis included a personal interview with the management, a review of such cost and production records as were available, and personal observations. 1/

(3) Data from time studies made during these personal observations at the plants that were in operation at the time of the visit.

(4) Basic operating data supplied by feed mill equipment manufacturers.

(5) Experience gained by the contractor; results of an earlier study pertaining to an analysis of cost standards in model formula feed mills producing about 7,500 tons, 25,000 tons, and 50,000 tons of feed per year. 2/

Characteristics of Custom Milling

The mail survey of 104 custom milling plants indicates that only 20 percent of the firms milled more than 2,000 tons of feed per year while 42 percent milled less than 500 tons per year. In addition, possibly because of this small annual volume, most custom milling is carried out as a sideline to some other type of business. More than one-half of the mills responding to the questionnaire reported that custom milling accounted for less than 10 percent of their total income. Firms reporting that custom milling accounted for 50 percent or more of their total income comprised only 3 percent of the total respondents.

It also might be considered a characteristic of this industry that many mill managers did not expect a reasonable profit from their custom milling operations since less than one-quarter cited profits as a reason for being in the business. 3/ In fact, almost one-half of those responding stated that

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1/ The cost and production records in most of the plants did not appear to be sufficient for use by management in decision making, and were not refined sufficiently to become the basic data for the type of analysis made in the study.

2/ Midwest Feed Manufacturers Association. "Cost Model for In-Plant Operations." Midwest Feed Production School Proc., 1956.

3/ Based on personal interviews at 36 mills.

their reason for engaging in custom milling was to serve customers and create good will. Apparently they look upon the milling operation as a necessary component of their major business, providing a service that helps increase sales of molasses and mixing concentrates and induces farmers to visit their establishment more often. In many of these instances the gross profits of the entire business are the single determining factor and the cost-profit relationship of custom milling is not considered as important as the other business that it generates. As might be expected, in the Midwest 75 percent of the mills contacted were country grain elevators. However, in almost all mills diversified merchandising of commercial feeds, fertilizers, farm machinery, and other supplies took place.

Equipment

The type of custom milling equipment used is normally determined by the farm community's requirements during the heavy feeding season. Since dairy and cattle feeders need molasses mixed into feeds, special molasses metering and blending equipment is sometimes necessary. Ten of the 36 mills visited had molasses blenders; several others used a dry molasses which can be mixed without special equipment.

Many farmers desire that their feed be put into pellets or crumbles. These processes require a steam plant and pellet mill, equipment which is expensive. The only plants observed that were equipped with pellet mills were those that also made a line of commercial feeds.

The annual tonnage of many midwestern custom feed mills is often substantially less than the machinery is capable of producing. However, a necessary part of "service" is the minimization of customer waiting time. Consequently, equipment capable of handling larger amounts is in general use. At the mills visited, grinding and mixing equipment was essentially similar and each mill's annual tonnage reflected available business and not machine capacities.

Equipment for custom milling and grinding is sometimes used for other purposes. For example, sometimes equipment is used for noncustom grinding of the mill's own grain, which is then sold as an end product. This is "commercial" grinding and permits longer, more economical runs. Other mills mix some brands of commercial formula feeds.

Grain elevators require little additional unloading equipment for custom grinding purposes. On the other hand, a feedstore or hatchery may need to add grain weighing and unloading facilities. Conversely, a feedstore will normally have a warehouse and equipment to handle sacked additives while an elevator operator will have to find warehouse space and buy equipment for receiving and storing additives. In either case, the warehouse should be large enough to allow economical quantity purchases. Most grain elevators and feedstores merchandise other ingredients and frequently require larger warehouses than a straight custom milling operation would justify.

The hammermill is one piece of equipment found in nearly all custom feed mills. It is capable of grinding a large variety of grains; different granulations are made by changing screens. It also uses much more power than any other piece of equipment in the average mill. At mills visited, the horsepower of hammermill motors ranged from 20-100. However, about 75 percent were in the 50-75 h.p. range. Only 4 of the 36 mills visited had more than one hammermill.

More than half of the mills were equipped to do other grain processing such as crimping, cracking, and cutting, on mill rolls or through burr mills.

In most of the mills, the weighing was done on a truck scale at grain receiving points. The mixing operation requires additional small platform scales for weighing premixed concentrates or other additives if they cannot be introduced in full-sack lots of known weight. The completed feeds are not weighed at delivery when the weight of each ingredient has been previously determined. The general nature of the business prompts different millers to use different weighing equipment. For example, country grain elevators that receive large quantities of grain have large capacity scales, dumps, and grain handling equipment. Feedstores and hatcheries frequently have only the minimum amount of weighing and receiving equipment.

Vertical batch mixers are widely used by small feed mixers. The horizontal type is more expensive and requires more floor space; its advantages are not sufficiently important to small feed mills. Both types are flexible and allow the finished feed to be either sacked at the mixer outlet or diverted by conveyor to holding bins or to the customer's truck.

Seven of the 36 mills had more than one mixer. Two or more mixers make it unnecessary to clean the equipment every time the type of feed is changed. Also, since some equipment is obsolete, additional equipment has been installed to prevent lost time when there is a breakdown. Approximately 76 percent of the mills were using a 1-1 1/2 ton mixer while an additional 20 percent used a mixer having 2 to 3 tons' capacity.

Much of the machinery used in these custom feed mills was very old and frequently was not put into the plant with a view toward capacity operation. If these mills were operated at capacity, bottlenecks in flow of material would quickly result. Equipment that large formula feed mills consider obsolete is frequently purchased second-hand by the custom mills.

Model Mill

Possible Mill Arrangement

The building customarily used by many custom feed mills is not one that was planned and built around the milling operation. Instead it represents the conversion of existing space or the result of additions to a structure currently being used. A desirable custom mill layout is shown in figure 1. This floor plan permits each customer to weigh and dump his grain and move out without

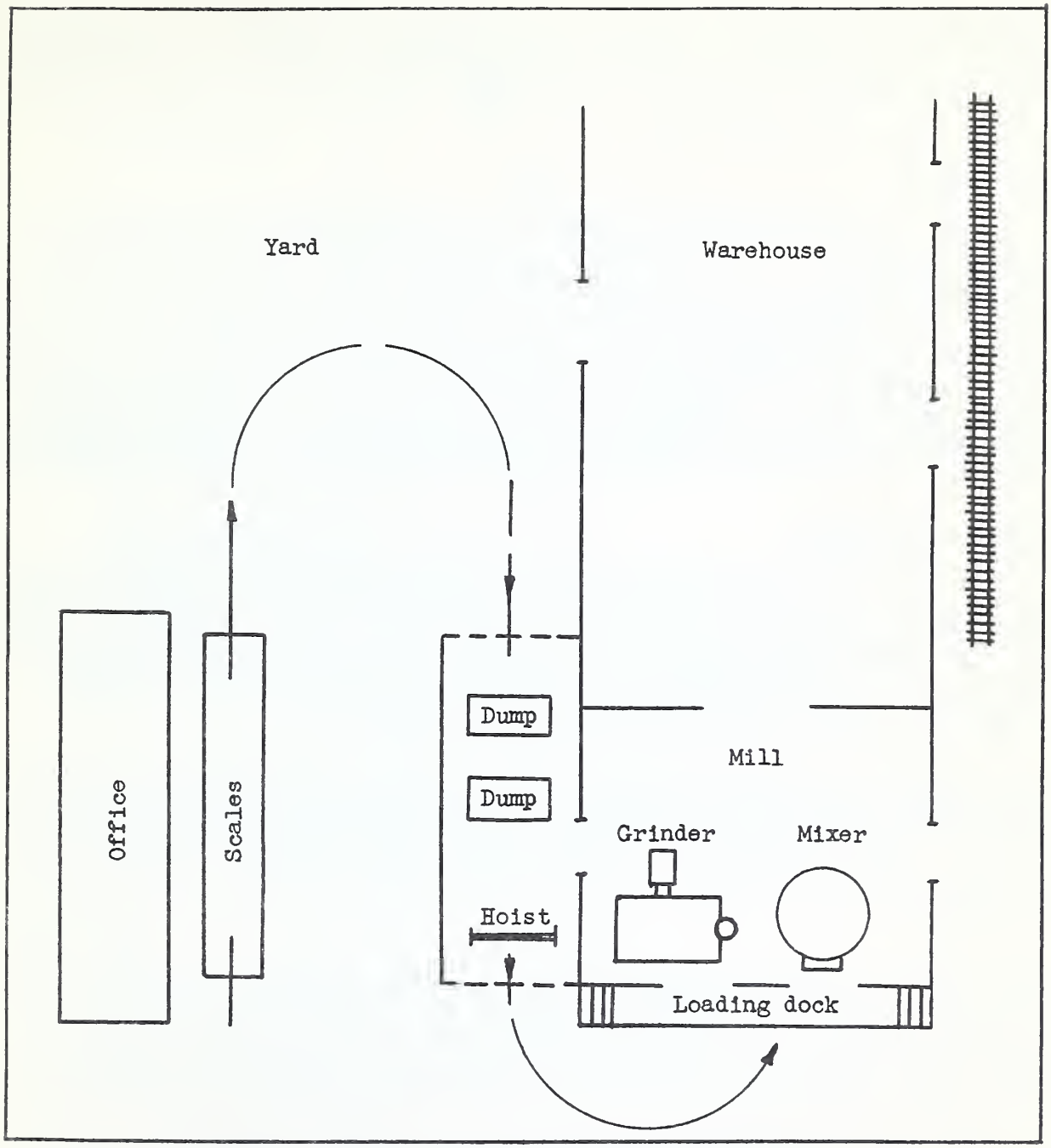

Figure 1.--Possible arrangement of custom feed mill. (Adapted from Bul. AE-250 "Modernizing Local Feed Mill Facilities in Ohio," J. W. Sharp, G. F. Henning, and C. W. Beaty, Ohio Agr. Expt. Sta. and Ohio State Univ., Dec. 1954. Mimeo.)

delaying other customers. The grinder and mixer are near the loading area and feed may be bulk-loaded in trucks by using portable conveyors or, if packaged, may be hand-trucked or carried to the loading dock as the sacks are filled and tied.

Flow Diagram

After the incoming grain is weighed on the truck scale and unloaded by hoisting the truck, the grain moves through the grain feeder or by gravity to the grinder (fig. 2). Following grinding to the proper texture, the grain is elevated by an air system through a blower spout to the dust collector and then moves by gravity to either holding bins or directly to the mixer. Here concentrates and premixes are dumped by the operator and incorporated with the ground grain. As soon as the mixing is completed, the feed is either sacked off the mixer spout or moved by conveyor to the customer's truck. There is adequate dock space for two trucks to load out simultaneously. This could be accomplished if two mixers are used or if holding bins are installed.

Equipment Investment

The model mill was designed around a 2-ton vertical mixer which is widely used by small mills and a 75 horsepower hammermill. Only 2 plants were using horizontal mixers while every mill used a hammermill. The cost range for these items as well as other equipment used in the model mill is shown in figure 2. The range of costs for each item is used because prices asked by equipment manufacturers vary according to specifications.

The grinder and the truck scale represented the largest items in the cost of equipment, with costs of grinding equipment varying as much as $1,500. The cost of the grinder includes the costs of an 8-inch blower spout and a dust collector. The total cost of equipment required for weighing, unloading, and grinding ranged from $11,200 to $15,333 including an allowance for installation and wiring.

The mixer is the most costly of the remaining equipment, ranging in price from $1,500 to $2,500. The total cost of the mixer and the equipment used to load grain into the mixer and to move feed from the mixer ranged from $2,755 to $4,389 including an allowance for installation and wiring. The total installed cost of equipment for the entire mill ranged from $13,955 to $19,722.

Since some agricultural areas have special feeding requirements, optional equipment to meet the particular needs of the area may be needed. A molasses tank, meter, and pump, all of which would be required for molasses handling, range in cost from $2,700 to $3,400, excluding installation. A crimper or cracker of 5 to 10 horsepower would cost between $700 and $900 while a crusher of 5 horsepower would cost between $900 and $1,000. Holding bins, with a 2-ton capacity, range in cost from $150 to $250. Sewing machines for bag closing and platform scales for bag weighing range in cost from $250 to $500 and $300 to $600 respectively. All of these costs for additional equipment are approximate and do not include allowances for installation and wiring.

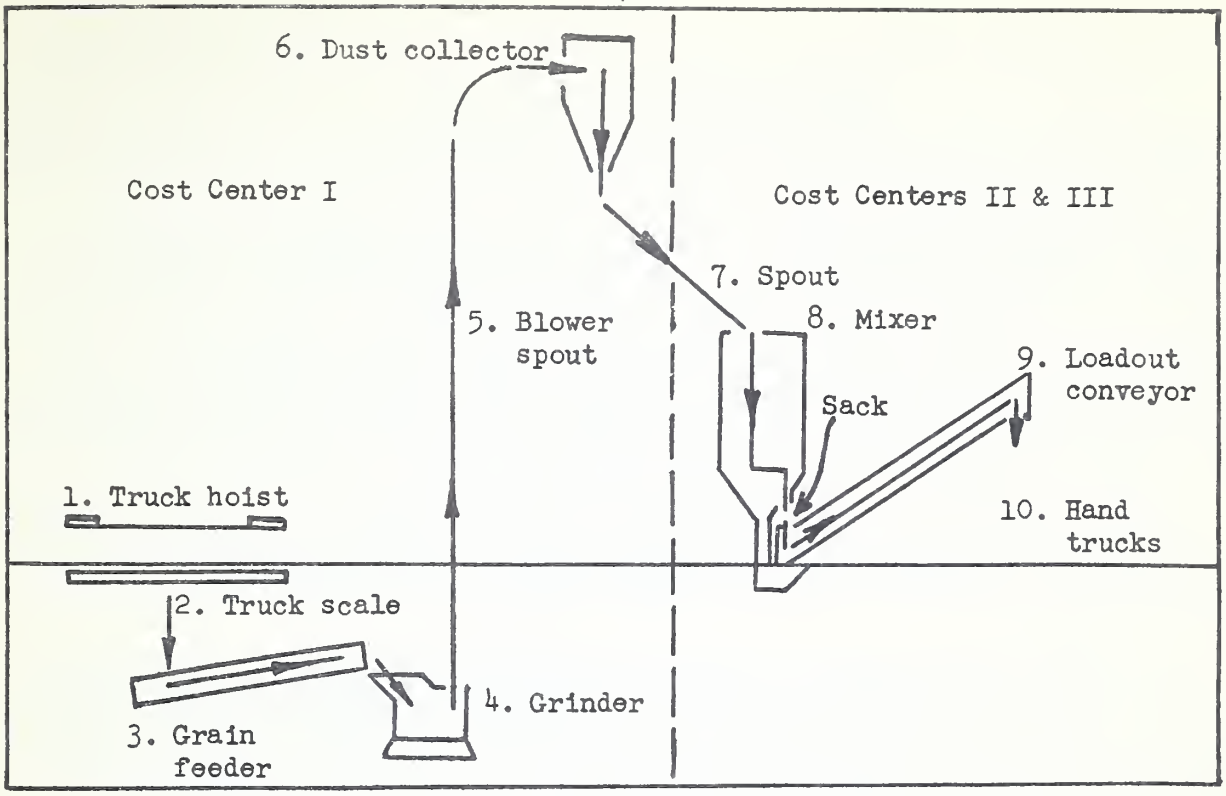

Figure 2.--Flow diagram and equipment capacities and cost range for model custom feed mill.

Cost centers and equipment	Diagram number	Capacity or size of unit	Horsepower	Approximate cost range
				Dollars
Cost center I				
Truck hoist	1	5 tons	5	900-1,000
Truck scale	2	20 tons	---	3,500-4,500
Grain feeder	3	4 1/2 tons per hr.	1-3	500-1,000
Grinder	4	4-8 tons per hr.	75)	
Blower spout	5	8-inch pipe	)	3,500-5,000
Dust collector	6	---	)	
Estimated installation cost 1/				2,800-3,833
Cost centers II and III				
Spout	7	8-inch pipe	---	15-25
Mixer	8	2 tons	10	1,500-2,500
Conveyor	9	4 tons per hr.	2-3	500-700
Hand trucks (2)	10	---	---	75-100
Estimated installation cost 1/				665-1,064
Total cost				13,955-19,722

1/ Allowance of 33 percent of equipment cost for installation and wiring.

Labor Standards in Model Mill

Many stationary custom mills operating in the Midwestern part of the country have the general layout and flow pattern shown in this model mill. Some of these mills operated with annual volumes of less than 500 tons and others with more than 5,000 tons per year. It is customary when establishing a model mill to choose the building, machinery, and other equipment to operate at or near capacity at the given production chosen for the model mill. The industry under consideration includes a majority of the plants operating considerably below the capacity of their plant, equipment, and manpower. For this reason, a model plant grinding and mixing in excess of 5,000 tons per year would have value to only a relatively small number of the custom mills.

On the other hand, to establish the operating volume of the model mill at the extremely low volumes noted among many of the custom mills would appear to be advocating a volume of operation which, under most circumstances, would result in a loss.

The standards determined by this survey are based upon an annual grinding volume of about 3,700 tons, an annual mixing volume of about 2,500 tons, and the packing or bagging of about 500 tons per year. In terms of daily operations the labor standards are based upon the custom grinding of 15 tons, mixing of 10 tons, and packing of 2 tons per 8-hour day.

This volume of operation was chosen after consideration of the above factors but primarily because (1) with this equipment and model plant one man could be expected to operate all phases and produce this output, and (2) preliminary cost and charges information indicates that under most circumstances this volume of operation could reasonably be expected to break even or return a profit. This does not mean that only one man should operate the plant. Other considerations such as delay of customers, available labor, etc., have caused many plants to use 2 or even 3 men in this type of an operation. It does mean, however, that if more than one man is used, other departments of the organization would have to assume that part of the time of 2 or 3 additional men which exceeded 8 hours per day. Likewise, it does not mean that a plant should not seek a larger custom volume, especially in view of the unused plant and equipment capacity.

Definition

Labor standards basically are an estimate of the production hours necessary to perform certain operations with a given plant and equipment. These standards must include, in addition to the time actually spent on each task or job, the time spent in moving between jobs, moving to other plant locations, and time out for personal requirements. In custom feed milling it also must take into account some waiting for the customers, answering customer questions on the correct formula to use, sales promotion, normal maintenance, etc., since many of these jobs are normally required of the custom feed mill employees.

Normally about 10 to 14 percent of an employee's time is required for personal requirements and rest. Including the time actually spent in moving from one job to another and to different plant locations, a 30-percent allowance was added to the production time in determining the labor standards for a larger formula feed mill mixing approximately 7,500 tons of feed per year. 4/

In view of the additional peculiarities of custom milling and on the basis of observations in actual plants an allowance of a 50-percent increase in production time will be used in this analysis.

These man-hour standards are not meant to be presented as perfect or ideal but they are standards which can be equalled or exceeded by mills with a plant layout and a daily output similar to the model mill. They are to be used as a method of measurement for the individual custom miller to evaluate the labor requirements and thereby determine the labor efficiency in his own plant.

Labor standards have been analyzed for individual operations, insofar as possible, and will be summarized separately for:

(1) Grain receiving and grinding

(2) Additive receiving and mixing

(3) Packaging or bagging

The operations conducted under items 1 and 2 above are necessary in all custom feed mills. Those conducted under item 3 above are necessary only in those plants bagging custom feed.

Grain Receiving and Grinding

In determining the labor standards for the grain receiving and grinding phase of the custom milling operation, it was assumed that a total of 15 tons was received and ground during each 8-hour day (table 1). The basic equipment used in performing this operation includes a truck scale, truck hoist, grain feeder, grinder and dust collector, cost center I (fig. 2).

Labor operations involved in this grain receiving and grinding phase are as follows:

1. Weigh loaded truck.

2. Start hoist motor to elevate truck, unload grain, and lower truck.

3. Sweep spilled grain into dump.

4. Weigh empty truck and compute net weight of grain delivered.

4/ See footnote 2, page 2.

Table 1.--Labor standards: Receiving and grinding 15 tons of grain per day in 2-ton loads

Job	Job standards	Minutes per day	Hours per day	Man-hours per ton
Grain receiving:				
Weigh loads of grain	1 minute per load	7.5		
Dump loads, sweep	5 minutes per load	37.5		
Move to grinder	5 minutes per load	37.5		
Total		82.5	1.375	
Grinding:				
Change screens	5 minutes 3 times a day	15		
Start and stop grinder	2 minutes per load	15.5		
Move to load out or mix	2 minutes per load	15.5		
Clean up	5 minutes per day	5		
Total		51	.833	
50 percent time allowance			1.104	
Grain receiving and grinding:				
Standard man-hours per day			3.312	
Standard man-hours per ton				0.221

5. Change grinder screens an average of 3 times per 8-hour day.

6. Start grinder and adjust flow.

7. Start grain feeder to move grain to grinder and shut off when pit is empty.

8. Stop grinder when operation is completed.

9. Clean area periodically.

10. Move ground grain to mixer or load out to customer's truck.

While this is the basic operation assumed in determining labor standards in the model mill, it must be recognized that special processing and special services rendered by individual custom mills may vary the type of equipment used or the steps taken. Basically, however, these labor standards can be changed to fit the individual mill operation by the inclusion of one or two estimates of the time required for these additional operations. The revised standard man-hours per day can in turn be multiplied by the individual plant's

tonnage of grain received and ground to determine an individual plant's standard man-hours per day, if the volume does not differ too much from the 15 tons assumed in this model operation.

In this model mill operation, the labor standards indicate that a man can handle about 4.5 tons of grain per hour or that 0.221 man-hours per ton are required (table 1). These standards also indicate that a majority of the worktime is involved in receiving the grain and moving it to the grinder.

Additive Receiving and Mixing

Labor standards in the additive receiving and mixing phase of the custom milling operation are based upon the mixing of 10 tons of custom feed, including the receiving and handling of 2.5 tons of additives or mixing concentrates (table 2). The basic equipment used in performing the work in this operation includes a 2-ton mixer, a conveyor for loading out, and a hand truck (cost center II and III, fig. 2).

Table 2.--Labor standards: Additive receiving and mixing 10 tons per day in 2-ton batches

Job	Job standards	Minutes per day	Hours per day	Man-hours per ton
Additive receiving:				
Receive 2.5 tons from truck and move to warehouse	6 tons per hour	25		
Total		25	0.416	
Mixing:				
Start mixer and move in 0.5 ton of additives	5 minutes 5 times a day	25		
Open 2.5 tons of bagged additives 1/	15 tons per hour	10		
Dump 2.5 tons of additives	20 tons per hour	7.5		
Wait on mixer	10 minutes per batch	50		
Clean up, etc.	4.5 minutes per batch	22.5		
Move to load out	2 minutes per batch	10		
Total		125	2.083	
50 percent time allowance			1.250	
Additive receiving and mixing:				
Standard man-hours per day			3.749	
Standard man-hours per ton				0.375

1/ Ground grain is received from grinder in a continuous flow.

Tasks performed by labor in this additive receiving and mixing phase are as follows:

1. Unload additives and move to warehouse

2. Move additives to the mixer.

3. Start mixer and flow of ground grain to the mixer.

4. Open and dump one-half ton of additives to each batch.

5. Sweep spilled feed into mixer.

6. Load out to customer's truck by connecting a portable conveyor from mixer to truck.

7. Stop mixer and loading conveyor.

8. Dispose of empty sacks and clean up.

The basic operations in most custom feed mills will be similar to those in the model mill except for variations in the volumes. Both the volume of additives handled and put into the mixer, and the total volume of feed mixed can be changed and new standards computed for man-hours per ton and per day.

On the basis of these standards, about 2.7 tons can be mixed per man-hour, or 0.375 man-hours are required to mix a ton of feed (table 2). Approximately one-fifth of the worktime is required for additive receiving and the remaining four-fifths to charge the mixer and mix the feed.

Packaging

Packaging or bagging the custom feed involves the following operations:

1. Obtain 40 burlap sacks each capable of holding at least 100 pounds.

2. Place empty sack under spout, open slide and fill (do not weigh).

3. Shake down full sacks and tie at top with twine.

4. Carry sack 10 feet to customer's truck.

In this model operation it is assumed that only 2 tons of custom feed will be packed per day (table 3). The remaining 8 tons are moved out in bulk. Changes in distances and the resultant time required and a correction in the average volume bagged will again permit the application of these standards to a given custom mill operation, if the differences in operation from the model mill are not too great.

Table 3.--Labor standards: Packaging one 2-ton batch per day

Job	Job standards	Minutes per day	Hours per day	Man-hours per ton
Packaging:				
Obtain empty sacks	4 minutes once a day	4		
Fill sacks	5 sacks per minute	8		
Hand tie sacks	5 sacks per minute	8		
Move to load out	4 sacks per minute	10		
Clean up	5 minutes per batch	5		
Total		35	0.583	
50 percent time allowance			0.292	
Standard man-hours per day			0.875	
Standard man-hours per ton				0.437

Standards for Entire Model Mill

The model mill, receiving and grinding 15 tons of grain, mixing 10 tons of feed, and bagging 2 tons per day, can deliver these custom mixed feeds to the farmer's truck with a theoretical total of 7.936 man-hours per day. This figure includes allowances for moving between jobs, talking with customers, standard maintenance, and personal requirements. Thus, excluding the possibility that plant management might want to use other labor intermittently, one man can handle the entire operation. The use of such labor would make it possible to reduce the amount of time that customers wait. This might be desirable in many mills. Nearly 1 hour of this man's time would be spent in packing, nearly 4 hours in additive receiving and mixing, and a little more than 3 hours in grain receiving and grinding.